Spinach

ATLANTIC PROVINCES VEGETABLE CROPS GUIDE TO PEST MANAGEMENT 2002 - 2003

Distributed By:
FARM EXTENSION SERVICES
P.E.I. DEPARTMENT OF AGRICULTURE AND FORESTRY

Prince Edward Island
CANADA
Agriculture and Forestry
Farm Extension Services

Publication No. 1400A
Agdex No. 250/600
Published January 2002

Table of contents:

Introduction
Crop Establishment
Crop Management
Nutrition
Pests and Pest Control
Harvesting and Handling
Storage and Conditioning
Bibliography
Weeds
Insects
Diseases
Print as PDF

Introduction

Spinach is a member of the Chenopodiaceae (Goosefoot family). Other vegetable crop members of this family are Swiss Chard and Beets. *Spinacia oleracea* is a low growing fleshly leaved annual that forms a heavy rosette of broad, crinkly tender leaves. This vegetable plant's cultivation began in Iran around 400 AD. The Arabs introduced spinach into Spain in 1100 AD and it spread to the rest of Europe by 1400 AD. The first savoyed leaf variety was introduced into North America in 1828.

Spinach prefers a cool climate. The minimum temperature for seed germination is 2ºC with a maximum germination temperature of 30ºC and an optimum range of 7 to 24ºC. Young plants can withstand temperatures as low as -9ºC. Best crop growth occurs at 15 to 20ºC with a minimum temperature of 10ºC and a maximum of 32ºC. In the Atlantic region spinach is grown in the spring from April and May seeding to mature from June 1st to mid July. The crop is also seeded in August and early September (up to 30-35 days before the first fall frost) for September and October harvest. This crop may also be overwintered if given protection and/or favorable winter weather (a snow cover). Spinach bolts rapidly when days are both long and hot. Plants reach market size in 40 to 70 days depending on the temperature, moisture, fertility, etc. Spinach requires a regular supply of moisture since it is a

shallow rooted crop.

Spinach can be grown on a variety of soils. Well drained sandy loams or loams well supplied with organic matter and high in pH are preferred for the early and wintered over crops because of good drainage and early soil warming. Peat soils may also be used and produce the highest yields.

Harvest of spinach usually begins the first week of June and continues until mid July or as long as weather and cultivar dictate. The fall crop can start in early September and extends up to late October depending on the local microclimate (fall frosts). Yields vary from 10,000 kg to 20,000 kg per hectare. Generally the more savoyed leaved cultivars were used for fresh markets and the smoother leaved ones for processing. But the smoother leaved cultivars are now used more for the packaged spinach (10 oz per bag) market as they are easier to wash and present a quality product. Often this product is now used as a salad vegetable. The use of tunnel houses could lead to earlier spring production (April and May).

Currently spinach is a minor crop with most of the crop grown for roadside markets or delivered directly to wholesalers. It is a crop that has increased in popularity as a salad crop and so there would seem to be potential for additional wholesale markets. It is also a potential processing crop.

▲ to Top

Crop Establishment

Seed Treatment - Seed can be sized to be precision seeded. Fresh seed will germinate readily at soil temperatures as low as 3 to 4°C and good results are obtained at 10 to 16°C. At higher temperatures there is a more rapid emergence but a decreased percentage germination. Spinach seed more than a year old rarely germinates over 80%. Older seed is even less viable and germinates more slowly and irregularly.

Seeding/Planting - Sow at a rate of 13 to 17 kg of seed per hectare when using non-precision seeders. Less than one-third of this will be needed if the crop is precision seeded. Sow seed at a depth of 0.5 to 1 cm and at a spacing of 25 seeds per meter of row for fresh market production and up to 40 per meter of row for processing production. Rows may be spaced 18 to 60 cm apart depending on cultivation equipment and plant population. Seed may be broadcast where weed control is not a problem. Sow seed outside as soon as soil can be worked in the early spring until mid to late May and then for fall crops during the month of August.

For field overwintering, seed during early September. For protected crop overwintering, seed can be sown in tunnel houses from mid October to mid November. Floating row cover can be used for winter protection.

Nutrient Content: Very good source of Vitamins A and C; good source of potassium, folate and iron. 250 mL (1 cup) cooked spinach provides 42 kilocalories; the same amount served raw supplies 8 kilocalories.

▲ to Top

Crop Management

Irrigation - on sandy soils irrigation should be provided if 2.5 cm per week of rainfall is not received.

▲ to Top

Nutrition

ALL ADDITIONS OF LIME AND FERTILIZER OR MANURES SHOULD BE BASED ON RECOMMENDATIONS FROM A SOIL TEST.

If spinach is stressed by a lack of nutrients, vegetative growth is retarded and the plants are more prone to bolting.

Manures - due to the weed seed contained in manures and the lack of effective herbicides, manures are not recommended. Also the nitrogen availability from manure is erratic for such a short season crop. Soils are also cold during the times spinach grows best. The fertility from manure is most available when soil temperatures are warm.

Lime - lime should be applied to maintain the soil pH in the range 6.5 to 6.8. Spinach is extremely sensitive to soil acidity.

Nitrogen - since spinach is such a short season crop and it is grown when soils are relatively cool at least half the nitrogen in the fertilizer should be in the nitrate form. Apply 70 kg of nitrogen per hectare preplant incorporated into the soil. Sidedress up to 50 kg of actual nitrogen per hectare 3 weeks after seeding. Do not apply nitrogen later than this as nitrate may accumulate in the leaf tissue. Urea may be applied as a foliar spray for part of the nitrogen requirements.

Phosphorus - as with most vegetable crops banded phosphorus would be ideal due to its close proximity to developing seedling roots. This crop has a relatively high requirement for phosphorus.

Potash - spinach is a heavy feeder in regard to potash especially at high yield levels.

Magnesium - foliar applications of magnesium may enhance the production of dark green leaves. Apply 12 to 15 kg of epsom salts per hectare. Magnesium deficiency has similar foliar symptoms to nitrogen deficiency (yellowing on older leaves). Use dolomitic limestone on fields to be cropped to spinach.

Micronutrients

Manganese - deficiency here usually occur due to over liming of the soil. This can be corrected with foliar sprays of manganese sulfate.

Boron - spinach is quite susceptible to boron deficiency. Apply boron in the fertilizer and as a foliar spray and/or soil drench.

Molybdenum - may be required especially where the soil is acid.

Application Method - broadcast the fertilizer and work into the soil preplant or band 5 cm below and 5 cm to the side of the seed row. Only band a portion of the potash. The balance of potash requirements should be harrowed into the soil prior to planting. Apply sidedressings or foliar nutrients if required.

▲ to Top

Pests and Pest Control

Weeds

Recommended herbicide will control only a small number of weed species. Annual and perennial weed populations must be reduced prior to planting. A number of shallow cultivations are an essential part of a weed control program. Manure should not be used on this crop due to its high weed seed content. Herbicides should be ordered early as they many not be readily available at planting time. Care must be taken to avoid fields where residual herbicides from previous years persist in the soil as crop injury may occur.

Diseases

Downy Mildew (fungus)

Characteristics: Causes indefinite, yellowish areas on the upper leaf surface. On the lower surface a gray mold appears. Affected areas turn black and die. Disease develops best in cool, moist weather.

Control: To control this disease use tolerant cultivars. Practice 3 year crop rotations and hot water treat the seed.

Fusarium Wilt and Root Rot (fungus)

Characteristics: Plants turn yellow and wilt, beginning with older leaves. The fungus attacks feeder roots first and then the tap root.

Control: Do not plant the crop when the soil temperatures are high (mid June to late August). The cultivar "Packer" has some tolerance.

Spinach Blight or Yellows (virus)

Characteristics: Caused by cucumber mosaic virus and transmitted by aphids. Young inner leaves become mottled, later changing yellow and finally they are killed. Older leaves gradually turn yellow. Symptoms develop much faster at higher temperatures.

Control: Grow resistant cultivars.

Insects

Spinach Leaf Miner

Characteristics: The adult is a slender grey fly 4 mm long. They are frequently seen

hovering over the host plants. Small green or white maggots feed inside the leaves, forming blotches. There are several generations a year; pupae overwinter in the soil. Flies lay eggs on the undersides of the leaves. Larvae enter the leaves, feed until mature, then drop to the ground, pupate, and emerge as flies. Colorless blotches with a silvery overcast are formed by the larvae mining between the surfaces of the leaves. This makes the crop unmarketable. Heavy infestations stunt growth.

Control: Insecticides should be applied when mining damage is first observed. Two to three treatments at 10-day intervals may be needed. Early in the season infestations may be suppressed by destroying infested crop residues and weeds. In large commercial fields leaf miner has not been a problem.

Aphids

Characteristics: Aphids are small, soft-bodied, slow-moving insects. They are often found in large colonies on the undersurface of leaves. A colony consists of winged and wingless adults and various sizes of nymphs. Aphids may be black, yellow or pink, but mostly are various shades of green. Aphids feed by sucking plant sap. Saliva injected while feeding may carry plant viruses or may be toxic to the host plant. Feeding by large numbers discolors foliage, and curls leaves. The plants may be covered by a sticky substance, honey dew, which is excreted by the aphids.

Control: Spray only if aphids are so numerous as to cause wilting of leaves during dry weather. Predators such as lady bird beetle (colored orange with black stripes or spots) and their larvae (black or purple with orange or white markings) usually control severe attacks of aphids.

SEE SPECIFIC CONTROLS IN THE ATLANTIC PROVINCES "GUIDE TO PEST MANAGEMENT" FOR VEGETABLE CROPS.

▲ to Top

Harvesting and Handling

The entire plant is usually harvested by cutting just above the ground level when there are at least 5 to 6 leaves - usually 40 to 70 days after seeding within the growing season. Older plants may have 10 to 12 leaves. Cutting should take place at the coolest time during the day and when the plants are dry. The crop should be harvested while the crop is lush and tender. This is before seed stalks harden and leaves become tough.

For the fresh market it is usually placed loose into pallets and then washed and cooled as quickly as possible. Spinach may be hydrocooled or bagged into retail packs and iced. Spinach has one of the highest respiration rates among fruits and vegetables so cooling is critical. Forced air cooling can be used on this crop. Vacuum cooling may be used if it is available.

▲ to Top

Storage

Spinach can be held 10 to 14 days at a temperature of 0ºC and a relative humidity of 95% to

100%.

▲ to Top

Bibliography

(See also General References)

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Diseases and Pests of Vegetable Crops in Canada. 1994. Canadian Phytopathological Society and Entomological Society of Canada. pp 50 to 60 and pp 407 to 409.

Prepared by: Horticulture Section, Production Technology Branch, Nova Scotia Department of Agriculture & Marketing on behalf of APASCC and members:

▲ to Top

PEST	PESTICIDE (Formulation)	RATE Product	DAYS TO HARVEST	REMARKS
Weeds ▲ to Top				
Preplant Perennial Weeds including quackgrass	ROUNDUP 356 Sn	2.5 to 7.0 L/ha	-	Apply in the fall or spring prior to planting. Annual weed control programs will be necessary to control weeds germinating after planting. For quackgrass control apply to actively growing quackgrass when at least 4 new leaves are present. The low rate (2.5 L/ha) will provide a minimum of one season control, while higher rates (4.75 to 7 L/ha) will provide longer term control. The low rate of Roundup should be applied in 50 to 100 L/ha water. If higher water volumes are used add a suitable surfactant. Wait 72 hours before plowing under. Best control of quackgrass is obtained when these herbicides are applied in the fall.
	TOUCHDOWN 480	2.5 to 7.0 L/ha	-	
	GLYFOS	2.5 to 7.0 L/ha	-	
	ROUNDUP TRANSORB	2.5 to 7.0 L/ha	-	
Preplant incorporated Germinating grasses	RO-NEET 720 EC	4.75 L/ha	-	Preplant incorporated on mineral soils only. Apply to a dry, clod-free soil and incorporate immediately.
Preemergence Germinating annuals	CIPC 4.8 EC	2.7 to 5.0 L/ha	-	Preemergence on mineral soils only. Use higher rates in warm weather, lower rates in cool weather and on sandy soils.
Stale Seedbed Technique	GRAMOXONE 200 Sn	2.75 to 5.5 L/ha	-	Apply in 300 to 1100 L of water/ha to foliage of the emerged weeds but before the crop has emerged. Use Gramoxone for best control of grasses.
	REGLONE 200 Sn	2.75 to 5.5 L/ha	-	
Postemergence Inter-row shielded	GRAMOXONE 200 Sn	2.75 to 5.5 L/ha	-	Do not spray solution on the crop plant since it could be injured or killed. Use Gramoxone for best control of grasses.
	REGLONE 200 Sn	2.75 to 5.5 L/ha	-	
Insects ▲ to Top				

Aphids	DIBROM EC	1.1 to 1.65 L/ha	4	
	THIODAN 4 EC	2.1 L/ha	14	Apply when aphids are numerous. Do not apply more than once per season.
	THIODAN 50 WP	1.7 kg/ha	14	
	ENDOSULFAN 50 WP	1.7 kg/ha	14	
	LAGON 480 EC	700 ml/ha	7	
	DIMETHOATE 480 EC	700 ml/ha	7	
Leafminers and Aphids	DIAZINON 500 EC	1.1 L/ha	10	Apply in sufficient water to ensure coverage.
	DIAZINON 50 WP	1.1 kg/ha	10	
	DZN 600 EW	0.915 L/ha	10	
	MALATHION 500 EC	2.5 L/ha	7	
	MALATHION 25 WP	5.5 to 7.0 kg/ha	7	
	GUTHION 50 WP	1.1 kg/ha	14	
	GUTHION Solupak 50%	1.1 kg/ha	14	
	SNIPER 50 WP	1.1 kg/ha	-	
	GUTHION 240 SC	1.8 to 2.2 L/ha	14	
SNIPER 240 EC	1.8 to 2.2 L/ha	-		
Diseases ▲ to Top				
Downy mildew	FIXED COPPER	Follow Manufacturer's directions	1	Apply at 7-10 day intervals in cool wet weather. Grow tolerant varieties.